EFFICIENCY IMPACT OF CONVERGENCE BIDDING ON THE CALIFORNIA ELECTRICITY MARKET
A DISCUSSION

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Market design change in CAISO market

- CAISO operates a day-ahead (DA) and a real time market (RT)
  - Market participants bid in DA and RT, algorithm generates prices and schedules, based on optimization under constraints
  - Cost-based compensation for ramp-up costs, minimum load
- Starting in February 2011 introduction of convergence bidding
  - Financial instrument designed to help market participants to arbitrage between the DA and RT price
    - Before: If $p^{DA} < E[p^{RT}]$, buy in DA market, sell in RT – execution risk + physical constraint
    - With CB: If $p^{DA} < E[p^{RT}]$, **at t-1**, buy in DA market, sell same qty in RT
  - Exposure limited by collateral deposited at CAISO
  - About 77 market participants in CB: electricity producers and consumers, investment banks, energy trading firms

Variable of interest: $E_{t-1}[p_{ht}^{DA} - p_{ht}^{RT}]$

- **Data**: hourly DA and RT for one hub of CAISO before (2010) and after (2012) the introduction of CB
- **Theoretical prediction**: CB should decrease (eliminate?) arbitrage opportunities $E_{t-1}[p_{ht}^{DA} - p_{ht}^{RT}]$
- **Descriptive statistics (realized prices)**
  - Mean DA-RT spread in 2010: -2.36
  - Mean DA-RT spread in 2012: -0.37
  - But huge variance !
- **Statistical model of $E_{t-1}[p_{ht}^{DA} - p_{ht}^{RT}]$**
  - Correlated assets (24 daily prices)
  - Accounts for regime changes, endogenously (hidden markov model)
  - Standard forecasting techniques

Results

- Based on estimated model, can simulate arbitrage possibilities
  - Expected return
  - Standard deviation of expected return
  - Reward-to-variability ratio (Sharpe)
- Expected returns, reward-to-variability ratio go down significantly suggesting that CB led to improved market efficiency
  - But there remains profitable arbitrage opportunities

Comments / questions

- **Role of different definitions of asset on limits to arbitrage ?**
  - Hourly DA bids vs every 5 min clearing in RT
  - Locational pricing for DA and RT versus hub-level pricing
  - Some reaggregation too for empirical analysis
  - Is it true that:
    - Arbitrage opportunity in model $\Rightarrow$ arbitrage opportunity in practice
    - Arbitrage opportunity in practice $\not\Rightarrow$ arbitrage opportunity in model
- **Other measures of increased efficiency ?**
  - « CB allows you to trade in DA at RT prices »

  $\rightarrow$ makes participation in DA more attractive

  $\rightarrow$ should be good for efficiency. Do we see this ?
- **What else does CB change ?**
  - Market power ? … etc